

**NEW FRONTIERS**

**DRAFT GUIDELINES AND CRITERIA FOR  
THE  
PHASE A CONCEPT STUDY**

**April 20, 2009**

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## **GUIDELINES AND CRITERIA FOR THE PHASE A CONCEPT STUDY**

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### INTRODUCTION

NASA will fund each investigation selected through the New Frontiers 2009 Announcement of Opportunity (AO) Step 1 competition to perform a Phase A concept study.

The concept study will constitute the investigation's Concept and Technology Development Phase (Phase A) of the Formulation process as outlined in NPR 7120.5D, *NASA Space Flight Program and Project Management Requirements*. The requirements in Section 4.4.2 of NPR 7120.5D are waived per footnote 16 of that document except for the information required by these Concept Study Report (CSR) Guidelines. New Frontiers missions are Category 2, with Class B payloads (per NPR 8705.4).

The concept study is intended to provide NASA with more definitive information regarding the cost, risk, and feasibility of the investigation, as well as a detailed plan for the conduct of an appropriate education and public outreach (E/PO) program and, if proposed, an optional student collaboration (SC), before final downselection for continuation beyond the concept study phase. The product of the concept study is a Phase A CSR to be delivered by each selected investigation team approximately ten months after the Project Initiation Conference. This document provides guidelines for preparing the CSR.

The PI shall provide a proposed set of Level 1 requirements, including the criteria for full mission success satisfying the Baseline Science Mission and the criteria for minimum mission success satisfying the Threshold Science Mission.

The PI-Managed Mission Cost shall not increase by more than 20% from that in the Step 1 proposal to that in the CSR, and in any case shall not exceed the PI-Managed Mission Cost cap specified in the AO. With NASA's concurrence, the project cost offered at the completion of Phase A shall be the cost for the entire life of the project. Any subsequent increase in this cost may be grounds for termination or cancellation of the investigation (see Section 4.1.4 of the AO).

Evaluation of the CSR is Step 2 of the acquisition process. NASA's review of the completed CSR will include all mission facets, including E/PO. Risk reduction that has been accomplished during Phase A will be closely reviewed.

Because the NASA evaluators may not have reviewed nor have had access to the Step 1 proposal, the CSR must be a self-contained document. All program constraints,

guidelines, definitions, and requirements described in the AO are applicable to the CSR except as noted herein. Specific guidelines and definitions for proposal preparation (Appendix B of the AO) are applicable to the CSR except where specifically amended in this document (*e.g.*, page counts are amended herein to account for the added degree of maturity expected for implementation of the investigation).

Proposers are responsible for the content and quality of the entire CSR, including parts that may be prepared by partner organizations or individuals. All assumptions and calculations should be carefully documented in the CSR and reviewed by the Principal Investigator (PI) and his/her team, to ensure that they are accurate and that they will satisfy NASA requirements.

The CSR is due by 4 p.m. Eastern Time, **December TBD**, 2010, at:

New Frontiers AO 2009  
Science Mission Directorate  
NASA Research and Education Support Services  
500 E Street SW, Suite 200  
Washington DC 20024-2760  
(202) 479-9030

The Step 2 evaluation process will also include site visits by the evaluation team to each investigation team, to receive oral briefings and, if needed, to receive clarification of material in the CSRs. These briefings will be conducted approximately 1 month following submission of the CSRs; scheduling will be addressed at the Phase A Kickoff meeting.

As the outcome of Step 2, the Selection Official of the Science Mission Directorate (SMD) expects to continue (*i.e.* to down select) one investigation to proceed into the subsequent phases of mission development for flight and operation. It is anticipated that the continuation decision will be made by May 2011 (target).

Immediately following downselection, NASA will implement the bridge phase for the continued investigation per the Bridge Phase statement of work (SOW) and cost proposal submitted in the CSR (see section J of this document). The bridge phase is intended to cover a four-month period of Phase B effort, to provide program continuity while the Phase B/C/D/E/F negotiations are completed.

NASA will not continue funding for investigations that are not selected to proceed. , Every investigation team will be offered a debriefing of the evaluations of its CSR.

Part I of this document describes the criteria by which NASA will evaluate the CSRs. Part II provides guidance for preparing the CSRs.

## PART I - EVALUATION CRITERIA

Evaluation of the CSRs will be conducted in a fashion very similar to the evaluation of the proposals, as described in Section 7.1 of the AO. However, this evaluation will consider in greater depth of detail all factors related to the probability of mission success and to the realism of the proposed costs to NASA. Furthermore, this evaluation will consider additional factors, such as E/PO, which enhance NASA's return on investment in the investigation.

Successful implementation of a New Frontiers investigation demands that the investigation be achievable within the established constraints on cost and schedule. The information requested in Part II of this document enables the evaluation panel to assess how well each mission team understands the complexity of its proposed investigation, its technical risks, and any weaknesses that will require specific action during Phase-B.

The evaluation criteria for the concept study are listed below. The approximate significance of each criterion is indicated by the percent weighting:

- Scientific merit of the investigation (will not be reevaluated unless it is determined that one or more of the science objectives have changed significantly from those described in the Step 1 proposal) (approximately 25%)
- Scientific implementation merit and feasibility of the investigation (approximately 25%)
- Technical, management, and cost (TMC) feasibility, including cost risk, (approximately 45%)
- The quality of plans for core E/PO and for a Student Collaboration (SC), if proposed. (approximately 5%)

Additional selection factors are:

- Total SMD Cost
- Programmatic factors

### **Scientific Merit of the Investigation**

Although it is expected that the science objectives of the investigation will not have changed from those in the Step 1 proposal, the CSR will be examined to determine whether implementation details that emerged in the course of the concept study may have effected significant changes to any of them. Provided that no significant changes are found in the science objectives, the peer review panel rating for scientific merit of the Step 1 proposal will remain applicable to the CSR. If a reevaluation of scientific merit is judged to be necessary, the New Frontiers Program Scientist will convene a peer review panel for that purpose. . The definitions and process for reevaluating this criterion will be the same as those used for the Step 1 proposal review.

## **Scientific Implementation Merit and Feasibility of the Investigation**

This criterion will be reevaluated in the CSR because science implementation is expected to be described at a higher level of maturity than the pre-Phase-A level described in the Step 1 proposal. The following factors will be considered in addition to factors B-1 through B-6 in Section 7.2.3 of the AO: maturity of proposed Level 1 science requirements, and plans for science operations and data acquisition.

## **Technical, Management, and Cost (TMC) Feasibility of the Mission Implementation, Including Cost Risk**

This criterion will be reevaluated in the CSR. The following factors will be considered in addition to Factors C-1 through C-3 in Section 7.2.4 of the AO.

The technical evaluation will examine the technical approach in its entirety to ensure that: (1) all elements and processes are addressed, (2) weaknesses and design issues are understood and plans for resolution have been identified, (3) fundamental design trades have been identified and studies planned or conducted, and (4) primary performance parameters have been identified and minimum thresholds established. Government Furnished Equipment (GFE), as defined in the AO, will be assessed to verify that it is being used within its intended capability. The overall approach (including schedule), the specific design concepts, and the known hardware/software will be evaluated for soundness, achievability, and maturity. Resiliency and design performance margins will be factors in this evaluation. The experience and expertise of the development organizations will be important factors in assessing the probability of success. Innovative cost effective features, processes, or approaches will be rewarded if proven sound.

Evaluation of the credibility and realism of the cost estimates and the planned financial resiliency will consider the underlying rationales for the cost estimates, including reserves, and the development schedule, including schedule margins.

Evaluation of Management will include consideration of roles, responsibilities, accountability, and decision making process; the processes, plans, and strategies the team will use to manage the various mission elements through all phases of the mission; evidence of clear lines of authority and clean interfaces; prudent scheduling; cost control mechanisms; review processes; demonstrated awareness of all necessary management processes; and the adequacy with which risk management activities are planned and budgeted. Additional factors in the evaluation of the probability of mission success will include the experience, expertise, and commitment of key personnel and the organizations to which they are attached, the adequacy of facilities and equipment proposed for the mission, and the adequacy of the management and control mechanism; the team's understanding of the scope of work (covering all elements of the mission, including contributions), the relationship of the work to the project schedule, the project element interdependencies, and associated schedule margins. Investigations proposing new technology will be penalized for risk unless adequate backup plans to ensure mission success are described. Innovative cost effective features, processes, or approaches will be rewarded if proven sound

The discussion of programmatic risks that are inherent in contributions, including risk mitigation plans and the demonstrated level of commitment by organizations responsible for providing contributions, will be evaluated.

The approach and feasibility for completing Phase-B will be assessed. The completeness of the Phase B plans will be considered in determining the adequacy of the Phase B approach. This will include an evaluation of the activities/products, the organizations responsible for those activities/products, and the schedule to accomplish the activities/products.

The Small Business and Small Disadvantaged (SDB) subcontracting plan will be evaluated on whether the proposer provides maximum practicable opportunities for small business participation and on the extent of participation of small disadvantaged business concerns. The effect of the subcontracting plan on the technical, management, or cost feasibility of the proposed investigation will also be evaluated. See Section 4.9 and Appendix A, Section XIII of the AO for details concerning small business and small disadvantaged business requirements.

### **Quality of Plans for Core E/PO Program**

The E/PO plan will be evaluated against the criteria described in the document *Explanatory Guide to the NASA Science Mission Directorate Education and Public Outreach Evaluation Criteria* (April 2008), which can be found in the New Frontiers Program Library. A discussion of these criteria is included in that document. See Section I of this document for further details on E/PO requirements.

### **Overall Merit of SC (if proposed)**

The evaluation of merit will include an assessment of whether the scope of the SC follows the guidelines in section 5.5.3 of the AO. The criteria to be used to evaluate the SC component and a discussion of those criteria are described in the document *Explanatory Guide to the NASA Science Mission Directorate Educational Merit Evaluation Factors for Student Collaboration Elements* (September 2007), which can be found in the New Frontiers Program Library. If the investigation is continued (down selected), NASA may elect either to fund or not to fund the SC.

In the final downselection decision, it may be necessary to consider NASA budget changes and other programmatic factors such as late breaking scientific mandates that were not evident when this AO was issued. Therefore, the Total Cost to SMD, as well as other programmatic factors, may be additional selection factors to be considered by the Selection Official,.

## PART II - REQUIRED QUANTITIES, MEDIA, FORMAT, AND CONTENT

Requirement CS-1. A CSR shall consist of one volume divided into readily identifiable sections that correspond and conform to Sections A through L of the following guidelines. It shall be typewritten in English and shall employ metric (SI) and/or standard astronomical units, as applicable. It shall contain all data and other information that will be necessary for scientific and technical evaluations; provision by reference to external sources, such as Internet websites, of additional material that is required for evaluation of the proposal is prohibited.

Exception: The cost proposal (Section K) may be submitted in a separate volume.

Requirement CS-2. All parts of a CSR, including photographs and/or colored graphics, shall be printed on recyclable white paper. Page size shall be either American standard 8.5 x 11 inches or European standard A4. Foldout pages (11 x 17 inches or A3) may be employed at the proposer's discretion, but see Requirement CS-4 for assessment of foldout pages against the page limit. Three-ring binders are acceptable.

Requirement CS-3. Text shall not exceed 55 lines per page. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch if printed on 8.5 x 11 inch paper; no less than 2.5 cm at the top and both sides, and 4 cm at the bottom if printed on A4 paper. Single-column or double-column formats are acceptable for text pages. Type fonts for text and figure captions shall be no smaller than 12-point (*i.e.*, no more than 15 characters per inch; six characters per centimeter). There is no minimum requirement for fonts used within figures and tables but all text in figures and tables shall be legible; fonts smaller than 8-point are often illegible.

Requirement CS-4. CSRs shall conform to the page limits specified in the *CSR Structure and Page Limits* table, below. A page quota larger than that in the Step 1 proposal has been allotted to accommodate greater maturity of detail in section F through H, plus E/PO plans and Phase B plan. In Sections E and F of the CSR, two extra pages each are allotted for each separate science instrument and two extra pages each are allotted for each separate flight element (*e.g.*, cruise element, landed element, sample return element, additional spacecraft). The total number of such extra pages shall not exceed a maximum of ten (10) regardless of the number of science instruments and flight elements. If applicable, ten extra pages are allotted for a Student Collaboration (SC). Every side of a page upon which printing appears will count against the page limits unless specifically exempted. Each foldout page will count as two pages against the page limits unless specifically exempted (*e.g.* cost tables required in Sections J and K).



**CSR Structure and Page Limits:**

<b>Section</b>	<b>Page Limits</b>
A. Cover Page and Investigation Summary	No page limit, but be concise
B. Fact Sheet	2
C. Table of Contents	No page limit
D. Executive Summary	5
E. Science Investigation (changes highlighted)	30
F. Science Implementation, including any Science Enhancement Options (SEOs) G. Mission Implementation H. Management I. E/PO, including any optional SC J. Bridge Phase and Preliminary Phase B Plan	98 + 2 pages/instrument + 2 pages/flight element +10 for SC
K. Cost Proposal for Phases A through F L. Justification and Cost Proposal for optional SEO Activities, if applicable	No page limit, but data must be presented in formats described; be brief
M. Appendices (No other appendices permitted) 1. Letters of Commitment 2. Relevant Experience and Past Performance 3. Resumes 4. Statement(s) of Work for Each Contract Option 5. Mission Definition and Requirements Agreement 6. Orbital Debris Analysis 7. Data Management Plan 8. Any Incentive Plan(s) 9. Any NASA PI Proposing Team 10. Technical Content of Any International Agreements 11. Discussion on Compliance with U.S. Export Laws and Regulations – Update from Proposal 12. Heritage 13. Acronyms List 14. Reference List (Optional) 15. Subcontracting Plan 16. Additional Cost Data to Assist Validation 17. Science change matrix 18. Communications Link Budget Design Data 19. Cost and Pricing for Bridge Phase Contract & Phase B	No page limit, but small size encouraged

Requirement CS-5. One copy of every CSR shall bear on its cover sheet the original signatures of the Principal Investigator and an official of the PI's institution who is authorized to commit its resources (see Section A, below). This "original" copy shall be printed on a single side of each page, and it shall be bound in a manner (*e.g.*, with a binder clip, with a rubber band, in an accordion folder, etc.) that allows it to be disassembled easily for reproduction in the event that NASA needs additional copies

The signed original of the CSR and fifty (50) paper "review" copies of the CSR are required; two-sided printing is required for the review copies. Each review copy shall be numbered. An additional 25 copies of the Fact Sheet (see Section C below) are required.

Requirement CS-6. A CD-ROM containing searchable PDF files of the CSR, limited to the main body of the CSR, all tables, and all appendices, as well as EXCEL files of cost tables, shall be attached to the original and all review copies of the CSR. These files must be identical to the paper copies. The Fact Sheet must also be submitted as a separate PDF file.

The CDs shall also contain an electronic version of the schedule. Each CD that will accompany the original or a copy of the CSR must include the required files. These CDs and the files in them must be compatible with both PCs and Macs.

The CDs must not have paper labels because, if they become unglued, slot-loading drives cannot read them. A permanent marker can be used to label the CDs.

Requirement CS-7. If science objectives provided with the Step 1 proposal have changed as a result of the concept study, these changes from the original proposal's science investigation section shall be clearly identified.

The required uniform format and contents are summarized below. Failure to follow this outline may result in reduced ratings during the evaluation process.

#### A. COVER PAGE AND INVESTIGATION SUMMARY

Requirement CS-8. A Graphic Cover Page and Summary Information, prepared as directed below, shall preface every CSR. These pages will not be counted against the page limits.

Requirement CS-9. The Graphic Cover Page shall contain, at a minimum, the following information and elements displayed on the cover page of the proposal:

- The investigation title;
- The name of the proposing organization;
- The name of the PI;
- The name and title of an official who is authorized to commit the proposing organization through the submission of the proposal;
- The signature of the PI and the authorizing official (unless these signatures appear on the Proposal Summary Information) only on the original copy, per requirement CS-5;
- Names and institutions of all participants in the investigation;
- The total NASA – SMD cost of the investigation;

- The proposed contributions and contributing organizations, and
- A summary of the investigation, not to exceed 300 words.

## B. FACT SHEET

Requirement CS-10. Every CSR shall include a fact sheet that provides a brief summary of the investigation. Information conveyed on this fact sheet shall include:

- Science objectives (including the importance of the science to the program science goals);
- Mission overview;
- Instrument complement;
- Key spacecraft characteristics;
- Mission management and participating organizations (including key teaming arrangements, as known);
- Anticipated need for curatorial services for returned samples, as applicable;
- Schedule summary;
- The proposed PI-Managed Mission Cost in real year dollars (RY\$) and in fiscal year 2010 dollars (FY10\$) from Table B3 in Appendix B of the AO; and
- The proposed Total Cost, including a breakdown of any contributed costs by contributing organization, in RY\$ and in FY10\$.

## C. TABLE OF CONTENTS

Requirement CS-11. The CSR shall contain a Table of Contents that parallels the outline provided in Sections C through M below. Figures and Tables shall also be included.

## D. EXECUTIVE SUMMARY

Requirement CS-12. The Executive Summary shall summarize of the contents of the CSR and shall include an overview of the proposed baseline investigation, including its scientific objectives, technical approach, management plan, cost estimate, and E/PO plans. The Executive Summary shall not exceed 5 pages in length.

## E. SCIENCE INVESTIGATION

Requirement CS-13. This section shall describe the science investigation resulting from the Concept Study. If there are no changes from the Step 1 proposal, this section shall be reproduced identically from the Step 1 proposal, with a statement that there are no changes.

Requirement CS-14. Any descoping of, or changes to, the investigation from the baseline and minimum mission science defined in the Step 1 proposal shall be identified and the rationale for the change(s) provided. Changes to the science investigation section from the original proposal shall be highlighted in bold or a color with column marking for easy identification. In addition, a change matrix showing the original (proposed) science

objectives, any new or revised science objective(s), rationale for the change(s), and its (their) location(s) within the CSR is required as an appendix (see Section M.17).

## F. SCIENCE IMPLEMENTATION

### F.1 Instrumentation.

Requirement CS-15. This section shall describe the instrumentation and the rationale for its selection. It shall identify the individual instruments and instrument systems, including their characteristics and requirements, and indicate items that are proposed for development, as well as any existing instrumentation or design/flight heritage. It shall provide a clear understanding of how the concept will provide the required data, show how it can be accommodated by the spacecraft, demonstrate that instruments have the necessary unobstructed fields-of-view over the measurement period required, describe the technology readiness levels and the approach to bring systems to technology readiness level (TRL) 6 at preliminary design review (PDR). If no development plan is needed, the reasons for this shall be explicitly stated and the rationale shall be described. A description of each instrument design, with a block diagram showing the instrument systems and their interfaces, along with a description of the estimated performance of the instrument, shall be included. These performance characteristics (which shall be considered as requirements on the flight system) shall include mass, power, volume, data rate(s), thermal, pointing (such as control, stability, jitter, drift, accuracy, etc.), spatial and spectral resolution, observable precision, retrieved parameter sensitivity and accuracy, and calibration requirements. This section shall demonstrate that the instrumentation can meet the measurement requirements, including factors such as retrieval results for each remote sensor, error analysis of the information in all sensors, vertical and horizontal resolution, signal-to-noise (S/N) calculations, etc. It shall also discuss effects, such as radiation and contamination, on each instrument's measurement capabilities as a function of mission time.

Requirement CS-16. The following information shall be provided for each science instrument proposed:

- Mass (include breakouts of electronics and optics);
- Viewing direction in body coordinates;
- Pointing accuracy and stability requirements
- Operational modes;
- Operational mode timeline;
- Data demand for each instrument operational mode;
- Onboard data processing and storage required from spacecraft;
- Power demand for each instrument operational mode including peak, average, and stand-by power; and
- Instrument thermal control capability.

### F.2 Data Sufficiency.

Requirement CS-17. This section shall discuss the quality and quantity of data to be generated by each instrument, as they relate to the proposed science investigation goals and objectives. The flow-down from science investigation goals to measurement objectives and instrument performance shall be stated clearly and supported by quantitative analysis.

### F.3 Science Mission Profile.

Requirement CS-18. This section shall discuss the science observing profile, including all mission-relevant parameters, such as orbit, navigation accuracy, operational time lines (including observing periods, data transmission periods and techniques, and time-critical events), etc. The manner in which the proposed investigation objectives, selected instruments, and measurement requirements drive the proposed mission design and operations plan should be apparent from this discussion.

### F.4 Data Plan.

Special attention must be given to assuring that both the planning and resources are adequate to analyze, interpret, and archive all the data produced by the investigation in the appropriate data archive. Resources include cost, schedule, and work-hours for scientific interpretation of results and publication.

Requirement CS-19. A schedule-based end-to-end data management plan, including approaches for data retrieval, validation, preliminary analysis, and archiving shall be described. The science products (*e.g.*, flight data, ancillary or calibration data, theoretical calculations, higher order analytical or data products, sample returns, witness samples, laboratory data, etc.) shall be identified, including a list of the specific data products and the individual team members responsible for the data products. The plan shall identify the appropriate NASA data archive and the formats and standards to be used. It shall include an estimate of the raw data volume and a schedule for the submission to the data archive of raw and reduced data in physical units accessible to the science community.

### F.5 Science Team.

Requirement CS-20. This section shall identify each key member (*i.e.*, one whose participation is essential to the success of the investigation) of the science team and his/her role and responsibilities. Resumes or curriculum vitae of science team members shall be included as appendices to the proposal (see Section J.3 of this appendix). The role of each co-investigator (Co-I) shall be explicitly defined, the necessity of that role shall be justified, and the funding source (NASA or contributed) for the PI and each Co-I shall be noted. Non-funded members of the science team shall be identified in the proposal as collaborators; the role of collaborators may be defined and justified.

### F.6 Plan for SEO.

Requirement CS-21. If applicable, this section shall describe plans for SEO activities (see Section 5.1.6 of the AO). Note that a justification and cost plan for SEO activities are required, additionally, in Section L of this document.

#### F.7 Level 1 Science Requirements

Requirement CS-22. This section shall describe the draft Level 1 requirements of the investigation.

### G. MISSION IMPLEMENTATION

#### G.1 General Requirements and Mission Traceability.

Requirement CS-23. This section shall provide a description of the spaceflight mission that is proposed to enable the science investigation. In some areas (*e.g.*, instruments), the data requested may have already been presented in another section of the CSR (*e.g.*, the Science Implementation section). In such a case, a CSR may provide a reference to that section and need not repeat the data in this section.

Requirement CS-24. The mission functional requirements that the science goals and objectives impose on the mission design elements, including mission design, instrument accommodation, spacecraft design, required launch vehicle capability, ground systems, communications approach, and mission operations plan, shall be provided in tabular form and supported by narrative discussion. Table B2 in Appendix B of the AO provides an example of a tabular Mission Traceability Matrix, with examples of matrix elements. Specific information that describes how the science investigation imposes unique requirements on these mission design elements shall be included.

This matrix, along with Table B1 in Appendix B of the AO provides the reference points and tools needed to track overall mission requirements, provides systems engineers with fundamental requirements needed to design the mission, show clearly the effects of any descoping or losses of mission elements, and facilitates identification of any resulting degradation to the science.

#### G.2 Mission Concept Descriptions.

Requirement CS-25. Designs for all elements of the mission shall be described in sufficient detail to demonstrate that the concept meets all of the basic requirements for a space flight mission, including mission design, spacecraft design, and supporting ground systems. Discussion of how the various mission elements meet the Mission Functional Requirements shall be included. At a minimum, the following mission elements shall be addressed as specified in the following requirements: mission design, flight system capabilities, mission operations, and any additional elements.

Requirement CS-26. This section shall address all elements of the mission design architecture, including the following elements to the extent that they are applicable to the mission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed.

- Launch readiness date (including launch date flexibility);
- Mission duration;
- Orbit type (Earth orbit, heliocentric, etc.) and orbit information (semimajor axis, eccentricity, inclination, node time of day, argument of perigee, altitude), and/or trajectory design, as applicable to the proposed investigation;
- Critical events; and
- Ground station(s) usage (*e.g.* location(s), and transmitting and receiving communication parameters).

Requirement CS-27. This section shall demonstrate compatibility with the proposed performance level launch vehicle by providing the fairing size, spacecraft mass, mission orbit characteristics such as altitude, (km – circular or apogee/perigee) inclination, C3, heliocentric and/or declination (DLA). Describe any known non-standard requirements such as additional fairing doors, cleanliness and purge requirements, planetary protection, *etc.*

Requirement CS-28. This section shall address all aspects of the flight system including the following flight system capabilities to the extent that they are applicable to the mission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be addressed. Note that the heritage of the components and subsystems are to be discussed in Appendix 12.

- Spacecraft Parameters:
  - (a) Figure of the complete spacecraft/instrument system, on the launch vehicle and in-flight, with major components labeled and approximate overall dimensions.
  - (b) Block diagram of the spacecraft subsystems and their components.
- Subsystem descriptions including structure, telecommunications, thermal, power, propulsion (if required), attitude determination and control, command and data handling, flight software, and ground software. (Note that the discussion of the telecommunications subsystem should be limited to specifications, design, and proposed component hardware – discussion of the link performance is addressed as part of the mission operations approach). Subsystem detail shall include the following information:
  - (a) Propulsion including (i) Delta-V budget; (ii) for each propulsion mode propulsion type(s) (monoprop, bi-prop, dual-mode, solar electric, etc.), engines and thrust levels, and specific impulse; propellant allocation (impulse vs. attitude control system); (iii) propellant margin including nominal (to meet Delta-V requirement) and additional (to meet mass growth).
  - (b) Command and Data Handling including (i) spacecraft housekeeping data rates for nominal and safing strategy; (ii) data storage unit size (Mbits); (iii) maximum storage record and playback rate.
  - (c) Power: (i) identify type of array structure (rigid, flexible, body mounted); (ii) solar array axes of rotation (vector projected in spacecraft coordinates); (iii) array size; (iv) solar cell type and efficiency; (v) expected power generation at Beginning of Life and End of Life; (vi) worst case Sun incidence angle to solar panels during science mission; (vii) battery type and storage capacity; (viii) worst case battery Depth of Discharge (DOD); (ix) spacecraft bus voltage.

- (d) Attitude Determination and Control, including system pointing requirements and capabilities. Describe or define the following: (i) each spacecraft operational mode including the sensors and actuators used, control method, and safing and/or contingency modes; (ii) attitude determination methodology and estimate of accuracy including identifying whether ground post-processing is required to meet science needs; (iii) agility requirements for slews or scanning; (iv) appendage pointing requirements including articulation control methods and deployment accommodations; (v) sensor selection and performance including identifying mounting location and field-of-view (FOV); (vi) actuator selection and sizing including identifying mounting location(s); (vii) translational maneuver (Delta-V) control and accuracy; (viii) momentum management approach and mitigation of impacts on navigation accuracy, if applicable; (ix) on-orbit calibrations, if required, including expected accuracy; (x) attitude control requirements for the spacecraft pointing control, pointing knowledge (at the instrument interface), pointing stability or jitter.
- (e) Thermal control, including (i) temperature requirements, (ii) temperature control approach (*i.e.* passive vs. active), and (iii) special thermal design considerations (*e.g.*, cryogenic instrument requirements).

Requirement CS-29. This section shall address any other major mission elements (*i.e.*, lander, upper-stage, etc.) to the extent that they are applicable to the mission. Any additional elements that are applicable to explaining the mission and demonstrating its feasibility shall also be discussed.

- Provide a block diagram and description of relevant subsystems; and
- Demonstrate that the design can accomplish the mission within the allocated resources.

Requirement CS-30. This section shall summarize contingencies and margins of all key flight systems resources. For the driving mission element requirements derived from the Mission Functional Requirements, it should provide estimates of implementation performance and design margins with respect to the required performance. At a minimum, it shall include the following:

- Mass;
- Propellants;
- Power;
- Data Storage; and
- Attitude Control System.

For any other driving mission element requirements derived from the Mission Functional Requirements, provide estimates of implementation performance and design margins with respect to the required performance (see table following Requirement B-34 in Appendix B of the AO for definition of margin).

Requirement CS-31. This section shall address the following elements of mission operations to the extent they are applicable to the mission. Any additional elements that are applicable to explaining the mission operations and demonstrating their feasibility shall also be addressed. This section shall provide, at a minimum,

- Description of ground systems and facilities including supporting ground software required for development and testing;



- Telecommunications, Tracking, and Navigation (Deep-Space/Lunar and Earth Orbital missions, as well as missions that utilize telecom relay orbiters) including (i) downlink information data volume, (ii) uplink information, (iii) for all transmit and receive modes, provide mode timeline, data rate(s), and durations, and (iv) ground network utilization plan including ground stations, downlink frequencies/ periods/ capacities/ margins, etc., retransmission capability;
- Plan for acquiring and returning critical event data, including clear identification of procurement and costing for supplemental resources (*e.g.*, mobile ground stations) if such are needed; and
- Operations plan, including nominal sequence planning and commanding, team training, availability of spacecraft experts for operations, operations center development

### G.3 Development Approach.

Proposers must address how all developmental problems, including those with new technology, will be addressed in order to ensure mission success.

Requirement CS-32. This section shall describe the development plan. This description shall include, at a minimum, the following items:

- Systems engineering approach (*e.g.*, plans, tools, processes for requirements, interfaces, and configuration management);
- Mission assurance plan, including (i) fault tolerance and fault management, (ii) product assurance, (iii) reliability (*e.g.*, use or non-use of redundancy, requirements for burn-in of parts, requirements for total operating time without failure prior to flight, *etc.*);
- Identification of instrument to spacecraft interfaces;
- Design maturity and heritage of mission elements (instruments, spacecraft, ground systems, and mission design, *etc.*);
- Essential trade studies;
- Management and closure of action items, hardware discrepancies, test anomalies, *etc.*; and
- Plan for handling special processes (*e.g.*, if radioactive sources are proposed, the approach to supporting the development, submittal, and approval of the necessary NEPA process and the Nuclear Safety Launch Approval process).

### G.4 New Technologies/Advanced Developments.

Requirement CS-33. This section shall describe any proposed new technologies and/or advanced developments, including NEXT or AMBR (if applicable), and the approaches that will be taken to reduce their associated risks. If no advanced development is required, the justification for TRL 6 or above shall be clearly demonstrated. These descriptions shall address, at a minimum, the following topics:

- Identification and justification of the TRL for each proposed new development and/or advanced development at the time the proposal is submitted (for TRL definitions, see NPR 7120.8, *NASA Research and Technology Program and Project Management Requirements*, Appendix J, in the Program Library);

- Rationale for combining the TRL values of subsystems to derive the full system TRL as proposed;
- Rationale for the stated TRL value of a system that is an adaptation of an existing system of known TRL;
- Plan for maturing each of the identified items to a minimum of TRL 6, defined as “system/subsystem model or prototype demonstration in a relevant environment, space, or ground” by the end of Phase B (include discussion of simulations, prototyping, systems testing, life testing, etc., as appropriate);
- An estimate of the resources (manpower, cost, and schedule) required to complete the technology development; and
- Fallbacks/alternatives that exist and are planned, a description of the cost, decision date(s) for fallbacks/alternatives, relevant development schedules, and performance liens they impose on the baseline design, and the decision milestones for their implementation.

#### G.5 Assembly, Integration, Test, and Verification.

Requirement CS-34. An illustration and discussion of the time-phased flow of the Integration and Test (I&T) Plan shall be presented. It shall summarize the key facilities, testbeds, and team members involved in the I&T Plan.

Requirement CS-35. The project's verification approach shall be described briefly in this section. Flow diagrams, narrative text, and/or other relevant data may be used to convey this information. Elements of the approach that pose special challenges for the project (*e.g.*, mission critical performance or functional requirements that can't be tested on the ground, special facilities that may be required for testing, large scale simulation tools that must be developed and how they will be validated, critical path items, etc.) shall be highlighted. The T&V description shall demonstrate the credibility of the overall T&V approach as reflected by consistency between the described test plans and the schedule, cost, and other resources needed to carry them out.

#### G.6 Schedule.

Requirement CS-36. A project schedule foldout covering all phases of the investigation and workflow for the complete mission life-cycle shall be provided. This foldout will not be counted against the page limits. The schedule format shall have a timeline granularity of months or finer, have a corresponding table of dates, and follow standard NASA WBS elements for task descriptions as prescribed in NPR 7120.5D. The schedule foldout and accompanying narrative shall address major milestones including, at a minimum, the following items:

- Spacecraft development and major review dates;
- Instrument development and major review dates including instrument-to-spacecraft/host integration and test;
- Ground systems development and major review dates (*e.g.*, mission operations and data analysis development schedule);
- Major deliverables (*e.g.*, ICDs, simulators, engineering modules, flight modules, *etc.*);
- Launch vehicle integration and launch readiness;

- Long-lead item specifications, development paths, and their impacts to schedule;
- Development schedule for SEOs, if any;
- Schedule critical path identification; and
- Funded schedule reserve, with indications of appropriate reserves associated with major milestones and deliverables.

## H. MANAGEMENT

The information provided in the Management section must demonstrate the proposer's plans, processes, tools, and organization for managing and controlling the development and operation of the mission, including performance measurement and reporting

Requirement CS-37. This section shall describe the management approach, including essential management functions and the overall integration of these functions. At a minimum, it shall describe:

- The organizational structure, including
  - (a) An organization chart that clearly indicates how the mission team is structured;
  - (b) The internal operations and lines of authority with delegations, together with internal interfaces;
  - (c) Relationships with NASA, major subcontractors, and associated investigators; and
  - (d) The names of the primary team members, their organization, and their reporting relationship in the program
- The decision-making process to be used by the team, focusing particularly on the roles of the PI and Project Manager (PM) in that process.
- The commitments and the roles and responsibilities of all institutional team members, including team members responsible for E/PO.

Requirement 38. A Work Breakdown Structure (WBS) as defined in NPR 7120.5D shall be provided. Each key position, including its roles and responsibilities, how each key position fits into the organization, and the basic qualifications required for each position, shall be described. A discussion of the unique or proprietary capabilities that each member organization brings to the team, along with a description of the availability of personnel at each partner organization to meet staffing needs shall be included. The contractual and financial relationships between team partners shall be described.

Requirement CS-39. This section shall describe the roles, responsibilities, time commitment, and experience of all team member organizations and key personnel, with particular emphasis placed on the responsibilities assigned to the PI, the PM, and other key personnel. In addition, information shall be provided that indicates the percentage of time key personnel will devote to the mission, the duration of service, and how changes in personnel will be accomplished.

Requirement CS-40. This section shall summarize the relevant institutional experience and refer to supporting detail included in Section M.2, Relevant Experience and Past Performance. If experience for a partner organization is not equivalent to, or better than, the requirements for the proposed mission, explain how confidence can be gained that the mission can be accomplished within cost and schedule constraints

Requirement CS-41. This section shall provide a history of experience explaining the relationship of the previous experience to each key individual's role; include the complexity of the work and the results. At a minimum, it shall address:

- Principal Investigator. The role(s), responsibilities, and time commitment of the PI shall be described. Provide a reference point of contact, including address and phone number.
- Project Manager. The role, responsibilities, time commitment, and experience of the named PM shall be described. Provide a reference point of contact, including address and phone number.
- Other Key Personnel. The roles, responsibilities, time commitments, and experience of other key named personnel in the investigation including Co-Investigators (Co-Is) shall be described.

Requirement CS-42. This section shall describe the Small and Small Disadvantaged Business (SDB) subcontracting plan and its effect on the technical, management, and cost feasibility of the investigation and refer to supporting detail in the preliminary SDB subcontracting plan in Section M.18.

Requirement CS-43. This section shall describe the management processes and plans necessary for the logical and timely pursuit of the work (including E/PO), accompanied by a description of the work plan. The proposed methods of hardware and software acquisition shall be described. The proposed management processes shall be described, including the following, as applicable: the relationship between organizations and key personnel; method(s) and tools to be used for internal review, control, and direction; systems engineering and integration; requirements development; configuration management; schedule management; team member coordination and communication; progress reporting, both internal and to NASA; performance measurement; and resource management. This discussion must include all phases of the mission including preliminary analysis, technical definition, the design and development, and operations phases, along with the expected products and results from each phase. Unique tools, processes, or methods which will be used by the investigation team must be clearly identified and their benefits discussed. All project elements must be covered to assure a clear understanding of project-wide implementation

Requirement CS-44. This section shall describe plans for risk management, both in the overall mission design and in the individual systems and subsystems. NASA's required risk management procedures are contained in NPR 8000.4, Risk Management Procedural Requirements, which is available through the New Frontiers Program Library. Plans for using standard risk management tools, including probability and impact charts, risk lists, mitigation plans and triggers shall be described. Plans for using reliability tools, such as fault tree analysis, probabilistic risk assessments, and failure modes and effects analyses, shall be described. Particular emphasis shall be placed on describing how the various elements of risk, including new technologies used, will be managed to ensure successful accomplishment of the mission within cost and schedule constraints. Investigations dependent on new technology will be penalized for risk if adequate plans to ensure

success of the investigation are not described. The top 3 risks and their mitigation plans must be discussed.

Requirement CS-45. A summary of reserves in cost and schedule shall be identified by Phase, project element, and year, and the rationale for them shall be discussed. The specific means by which integrated costs, schedule, and technical performance will be tracked and managed must be defined. Specific reserves and the timing of their application must be described. Management of the reserves and margins, including who in the management organization manages the reserves and when and how the reserves are released, must be discussed. This must include the strategy for maintaining reserves as a function of cost-to-completion. All funded and unfunded schedule margins must be identified. The relationship between the use of such reserves, margins, potential descope options, and their effect on cost, schedule, and performance must be fully discussed. When considering potential descope options, consider the investigation as a total system including instrument(s), spacecraft, ground system, launch services, and operations.

Requirement CS-46. This section shall clearly delineate the Government-furnished property, services, facilities, etc. required to accomplish all phases of the mission.

Requirement CS-47. This section shall list the major project reviews expected to be conducted during the project's life cycle and the approximate time frame of each. The objective of each review must be indicated. Note that regular reviews of the progress of the E/PO component of the missions must be held in the same way that progress on the scientific and technical aspects are reviewed.

Requirement CS-48. This section shall clearly describe the approach to reporting progress to the Government and indicate the progress reviews the Government is invited to attend to provide independent oversight. The process, including the individual or organization responsible for reporting integrated cost, schedule, and technical performance must be discussed. A description of the information to be presented must be included.

Requirement CS-49. This section shall describe plans to retire risk due to uncertainty associated with contributions by the end of Phase A. At a minimum, it shall address:

- Letters of commitment from all organizations involved in a contribution, particularly including the implementing organization (e.g., laboratory or institute) and, if external funding is required, the funding agency (e.g., national space agency). The letter must explicitly describe the nature of the contribution and its value. The letter must be clear concerning the origin of the funding for all aspects of the contribution (e.g., personnel and procurements). The letter must be signed by an official who is authorized to commit the organization to the commitments described in the letter. . A firm letter of commitment from international partners must be provided no later than the site visit.
- Mitigation plans, where possible, for the failure of funding or contributions to be provided when that funding or contributions is outside the control of the PI. Mitigation may include, but is certainly not limited to, descopeing the contributed items and/or holding reserves to develop the contribution directly. Note that reserves held for this purpose are not unencumbered. When no mitigation is possible, this must be explicitly acknowledged.

- Acknowledgement of the complexities and risks involved with contributions, and plans to handle those complexities or risks. This includes the schedule risk for implementing technical assistance agreements and international agreements. An adequate and realistic schedule must be allocated for having international agreements executed. NASA will not begin working on any international agreements until after the downselect decision is made.

#### I. EDUCATION AND PUBLIC OUTREACH (including Student Collaboration, if proposed)

Every investigation must include an E/PO plan its CSR.

Requirement CS-50. This section shall describe a detailed E/PO plan. At a minimum, this plan shall include:

- A summary description of the planned E/PO effort;
- A summary of the benefits offered by the mission beyond the scientific benefits brought by obtaining and analyzing the desired scientific data;
- Plans for product development and dissemination, contributions to the training of underserved and/or underutilized groups in science and technology, arrangements with partners, schedules and budgets for activities, and *etc.*, defined in sufficient detail to be evaluated at an appropriate level of depth.
- Where appropriate, references to the Management Plan (Section H of these guidelines) and other relevant sections for information on how the work is to be arranged, directed, implemented, reviewed, and reported.
- Letters of commitment from partners/subcontractors and resumes from key E/PO personnel shall be included as appendices to the CSR (Section M.1 of these guidelines).

The development schedule of the SC shall be described and a description of how it can be developed so as to be separable from the proposed baseline science investigation and performance floor science investigation shall be provided. Review and decision points for the SC readiness for flight must be identified.

Requirement CS-51. If a SC was proposed in Step 1, this section shall describe a detailed plan for the SC. At a minimum, this plan shall include:

- A statement that clearly identifies the SC as an E/PO element;
- A summary description of the planned SC;
- A development schedule for the SC, including decision points for determining readiness for flight;
- A demonstration of how the SC will be incorporated into the mission investigation on a non-impact basis;
- A demonstration of how the SC will be clearly separable from the rest of the mission investigation;
- An adequate plan for the mentoring and oversight of students to maximize the opportunity for teaching, learning, and success in contributing to the mission; and
- Identify the cost of the SC separately from the investigation.

## J. BRIDGE PHASE AND PRELIMINARY DESIGN AND TECHNOLOGY COMPLETION (PHASE B) PLAN

Requirement CS-52. This section shall address plans for the bridge phase, a priced option in the Phase A contract that will be exercised for the continued (down selected) investigation. The plan shall include a detailed schedule and shall define the products to be delivered from the bridge phase, as well as the schedule for their delivery. The following required deliverables will be due at the end of the bridge phase: a) complete set of Preliminary Level 1 requirements including mission success criteria; b) draft Descope Plan; and c) preliminary Project Plan.

Requirement CS-53. This section shall address plans and products for the Preliminary Design and Technology Completion Phase (Phase B). It shall identify the key mission tradeoffs to be performed and options to be investigated during Phase B that could lead to reductions in risk of implementation, including those issues, technologies, and decisions points critical to mission success. This section shall also describe and provide the rationale for any anticipated long-lead acquisitions.

Requirement CS-54. The Phase B Plan shall include a detailed schedule, and shall define the products to be delivered and the schedule for their delivery. The schedule shall include the PDR and deliveries of the following required products: a) detailed Descope Plan including the criteria, impact and savings of descope options; b) complete set of Baseline Level 1 requirements including mission success criteria; and c) baseline Project Plan.

## K. COST PROPOSAL

Requirement CS-55. This section shall detail the estimated cost of the proposed investigation. The estimated cost shall encompass all proposed activities, including all applicable mission phases, mission unique or special launch services, flight systems, ground systems, ground network fees, contributions, core E/PO program, any other AO-specific activities (*e.g.*, SC), and all cost reserves. These costs shall be consistent with the policies and requirements in Sections 4 and 5 of the AO.

Requirement CS-56. This section shall describe the methodologies used to develop the cost estimate and provide an overview of the cost estimate development process. Any additional cost estimates or other validation efforts shall be described, the results presented, and any significant discrepancies discussed. The rationale for the proposed cost reserve levels shall be presented. Additional Basis of Estimate data shall be provided to assist the validation of the costs estimates. Examples of useful Basis of Estimate data include cost comparisons to analogous items/missions, vendor quotes, and parametric model results.

Requirement CS-57. This section shall discuss cost risks.

Requirement CS-58. This section shall provide a foldout cost table, Table B3, which will not be counted against the page limit. Table B3 shall identify the proposed cost required in each mission phase and in each fiscal year; the costs shall be in RY\$. The top portion of Table B3 shall contain cost data relevant to the PI-managed Mission Cost. The lower portion shall contain cost data for contributions and enhanced mission costs. The rows in Table B3 shall be the NASA standard WBS elements as defined in NPR 7120.5D. The costs for most elements shall be provided to WBS level 3,. Exceptions are the costs of individual instruments and any unique flight system elements such as landers or sample return capsules, which shall be explicitly shown. The columns in Table B3 shall be grouped and subtotaled by mission phase and shall be labeled with the appropriate fiscal years. Fiscal years that span more than one mission phase shall be split into two columns by mission phase. The final two columns are totals in RY\$ and totals in FY10\$. Proposers shall use their own forward pricing rates to translate between RY\$ and FY10\$. For organizations that are without approved forward pricing rates, proposers may use the NASA inflation/deflation indices in Table B4 in Appendix B of the AO to translate between real year dollars (RY\$) and fiscal year 2010 dollars (FY10\$FY10\$).

Requirement CS-59. The CSR cost proposal shall provide information on the anticipated costs for all mission phases. A detailed cost proposal is required for each of the following Phases: the Bridge Phase, and Phase B. Cost estimates are also required for the follow on phases (C/D, and E, F ) including a description of the estimating techniques used to develop the cost estimates. Specific information that would better enable NASA to validate costs (e.g., WBS level-3 data) may be provided as an appendix (see Section M.16). See Section L for requirements for any SEO costs. A discussion of the basis of estimate shall be provided, with a discussion of heritage and commonality with other programs. Quantify and explain any cost savings that result from heritage. All costs, including all contributions made to the investigation, shall be included.

Requirement CS-60. A summary of total mission cost by fiscal year shall be provided, as shown in Table 1, Total Mission Cost Funding Profile Template. The purpose of this summary is to present all costs for the project *on one page*, by project phase (A through F), by participating organization, and by fiscal year. If obligation authority in excess of identified costs is required, the authority needed by year shall be indicated.

Requirement CS-61. For Phase B only, a Time Phased Cost Breakdown for each WBS element, as shown in Table 2, shall be completed in one page. Use only the line items shown in Table 2 that are relevant for each phase of the project. The purpose of this set of tables is to provide detailed insight into how the project allocates funding during each phase of work.

Requirement CS-62. The cost of the entire project shall be summarized on one page, and presented in the format shown in Table 3. The purpose of Table 3 is to (1) provide detailed insight into project costs by cost element and (2) provide a basis for comparison of the project proposed cost with the evaluation team's independent cost analysis. Identify each reserve amount to the lowest level consistent with the proposed reserve management strategy. For example, if each subsystem manager will have spending authority over a reserve for the subsystem, each such amount shall be identified separately. If more convenient, the reserve details may be shown in a separate table, with totals reported as



shown in Table 3. Show costs (NASA SMD and contributed) associated with each Co-I in the format of Table 4 in one page.

All Co-Is shall be included in Table 4. Note that all contributions, including Co-I support, must be documented by a letter of commitment.

Requirement CS-63. All contributions provided by NASA Centers, including Civil Servant services, as well as the cost for the use of Government facilities and equipment on a full-cost accounting basis, shall be included. All direct and indirect costs associated with the work performed at NASA Centers shall be fully costed and accounted for in the proposal and summarized in one page using the template provided in Table 6. The purpose of this data is twofold: 1) to determine those costs that are included in the NASA SMD cost but are not funded out of the New Frontiers program, and 2) to determine civil service contributions that are not included in the NASA SMD cost. Teams should work with their respective NASA Centers to develop estimates for these costs.

Definitions for cost element terms shown in the cost tables are provided in Appendix C.3 of the AO. This is not to be confused with the elements of cost listed in 1.f below.

Requirement CS-64. The inflation index provided in Appendix B (Table B4) of the AO shall be used to calculate all real-year dollar amounts, unless an industry forward pricing rate is used. If something other than the provided inflation index is used, the rates used must be documented.

Requirement CS-65. All costs shall include all burdens and profit/fee in real-year dollars by fiscal year, assuming the inflation rates used by NASA (Table B4) or specifically identified industry forward pricing rates.

Requirement CS-66. This section shall provide a detailed cost proposal for performing the Bridge Phase and Phase B. The cost proposal should correlate with the plans set forth in the Science, Technical Approach, and Management sections of the concept study. This cost proposal shall include the following elements:

- a. Contract Pricing Proposal. Cost or pricing data is required for the Bridge Phase and Phase B Phase. Complete cost or pricing data must be included with the CSR proposal for each organization participating in the Bridge Phase and Phase B and must be signed by each organization's authorized representative. This requirement may be satisfied with one form, provided that all institutions involved in the Bridge Phase and Phase B are included with the appropriate signatures. The contract pricing proposal for the Bridge Phase and Phase B Phase may be provided as an appendix (see Section M.19).
- b. Work Breakdown Structure. A WBS must be included for Phases B including the Bridge Phase. The structure of the WBS should be consistent with the plans set forth in the Technical Approach and Management sections of the concept study and the Statement of Work provided as an Appendix to the concept study. The WBS shall be described to the subsystem level (e.g., Attitude Control System,

- Propulsion, Structure and Mechanisms) for the spacecraft and to at least the instrument level for simple instruments and to the major component level for more complicated instruments. All other elements of the WBS must be at least to the major task level (e.g., Project Management, Systems Engineering, Ground Support Equipment).
- c. Workforce Staffing Plan. Provide a workforce staffing plan which is consistent with the WBS. This workforce staffing plan must include all team member organizations and must cover all management, technical (scientific and engineering), and support staff. The workforce staffing plan must be phased by month. Time commitments for the PI, PM, Co-Is, and other key personnel must be clearly shown.
  - d. Proposal Pricing Technique. Describe the process and techniques used to develop the cost proposal for the Bridge Phase and Phase B. For portions of the cost proposal developed using a grass-roots methodology, provide the bases from which the estimates were derived and details on how the estimates were extrapolated from the bases. For portions of the cost proposal derived from vendor quotes/historical actuals/catalogue prices/etc. include sufficient information to understand the fidelity of the values. For portions of cost the proposal derived from analogies, describe the value of and the methodology for extrapolating the analogy. For portions of the cost proposal derived parametrically, provide a description of the cost-estimating model(s) and techniques used in the cost estimate for Bridge Phase and Phase B. Discuss the heritage of the models and/or techniques applied to this estimate, including any known differences between missions contained in the model's data base and key attributes of the proposed mission. Include the assumptions used as the basis for the cost for Bridge Phase and Phase B and identify those which are critical to cost sensitivity in the investigation. If any "discounts" were assumed in the cost estimates for business practice initiatives or streamlined technical approaches, describe how these have been incorporated in the cost estimate and will be managed by the investigation team.
  - e. Bridge Phase and Phase B Time-Phased Cost Summary. Provide a summary of the total costs for the Bridge Phase and Phase B consistent with Table 2. The cost summary for the Bridge Phase and Phase B should be developed consistent with the WBS and must include all costs to NASA SMD along with all contributed costs. The time phased cost summary for the Bridge Phase and Phase B must be phased by month.
  - f. Elements of Cost Breakdown. To effectively evaluate the cost proposals for the Bridge Phase and Phase B, NASA requires cost or pricing data as defined in FAR 15.401 and supporting evidence stating the basis for the estimated costs by the WBS levels used in Table 2. This information is in addition to that provided in Tables 1 through 5. The proposal will include, but is not limited to the following elements of cost:

- i. Direct Labor.
  - (1) Explain the basis of labor-hour estimates for each of the labor classifications.
  - (2) State the number of productive work-hours per month.
  - (3) Provide a schedule of the direct labor rates used in the proposal. Discuss the basis for developing the proposed direct labor rates for the team member organizations involved; the forward-pricing method (including midpoint, escalation factors, anticipated impact of future union contracts, etc.); and elements included in the rates, such as overtime, shift differential, incentives, allowances, etc.
  - (4) If available, submit evidence of Government approval of direct labor rates for proposal purposes for each labor classification for the proposed performance period.
  - (5) If Civil Servant labor is to be used in support of the Phase B study, but is not to be charged directly to the investigation, then this labor must be considered as a contribution by a domestic partner, subject to the same restrictions as other contributions by domestic or foreign partners. A discussion of the source of funding for the Civil Servant contributions must be provided.
- ii. Direct Material. Submit a summary of material and parts costs for each element of the WBS.
- iii. Subcontracts. Identify fully each effort (task, item, etc. by WBS element) to be subcontracted, and list the selected or potential subcontractors, locations, amount budgeted/proposed, and types of contracts. Explain the adjustments, if any, and the indirect rates (or burdens) applied to the subcontractors' proposed or anticipated amounts. Describe fully the cost analysis or price analysis and the negotiations conducted regarding the proposed subcontracts.
- iv. Other Direct Costs.
  - (1) Travel, Relocation, and Related Costs. Provide a summary of the travel and relocation costs including the number of trips, duration, and purpose of the trips.
  - (2) Computer. Provide a summary of all unique computer-related costs.
  - (3) Consultants. Indicate the specific task area or problem requiring consultant services. Identify the proposed consultants, and state the quoted daily rate, the estimated number of days, and associated costs (such as travel), if any. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
  - (4) Other. Explain and support any other direct costs included in the proposal for Phase B in a manner similar to that described above.
- v. Indirect Costs.
  - (1) List all indirect expense rates for the team member organizations. Indirect expense rates (in the context of this AO) include labor overhead, material overhead, general and administrative (G&A) expenses, and any other cost proposed as an allocation to the proposed direct costs.

- (2) If the proposal includes support services for which off-site burden rates are used, provide a schedule of the off-site burden rates. Include a copy of the company policy regarding off-site vs. on-site effort.
- (3) If available, submit evidence of Government approval of any/all projected indirect rates for the proposed period of performance. Indicate the status of rate negotiations with the cognizant Government agency, and provide a comparative listing of approved bidding rates and negotiated actual rates for the past five fiscal years.
- (4) Discuss the fee arrangements for the major team partners.

Requirement CS-67. This section shall provide a cost estimate for performing the Final Design and Fabrication/System Assembly, Integration and Test, and Launch (Phase C/D) portion of the mission. The Phase C/D cost estimates shall correlate with the plans set forth in the Science, Technical Approach, and Management sections of the CSR. In completing this section, the following guidelines will apply:

- a. Work Breakdown Structure. A WBS should be included for Phase C/D. The WBS shall be described to the subsystem level (i.e., Attitude Control System, Propulsion System, Structure and Mechanisms, etc.) for the spacecraft and to the instrument level for the payload. All other elements of the WBS should be to the major task level (Project Management, Systems Engineering, Ground Support Equipment, E/PO, etc.).
- b. Cost Estimating Techniques. The process and techniques used to develop the Phase C/D cost estimate shall be described and a description of the cost estimating model(s) and techniques used in the Phase C/D cost estimate shall be provided. The heritage of the models applied to this estimate including any known differences between missions contained in the model's database and key attributes of the proposed mission shall be discussed. Include the assumptions used as the basis for the Phase C/D cost and identify those that are critical to the cost sensitivity in the investigation. Identify any "discounts" assumed in the cost estimates for business practice initiatives or streamlined technical approaches and the basis for these discounts. Describe how these have been incorporated in the cost estimate and will be managed by the investigation team.
- c. Workforce Staffing Plan. A workforce-staffing plan (including civil service) that is consistent with the WBS shall be provided. This workforce-staffing plan shall include all team member organizations and should cover all management, manufacturing, technical (scientific and engineering), E/PO, and support staff. The workforce-staffing plan shall be phased by fiscal year. Time commitments for the PI, PM, and other key personnel shall be clearly shown.
- d. Phase C/D Time-Phased Cost Summary. A summary of the total Phase C/D costs consistent with the WBS in Table 3 shall be provided. The Phase C/D cost summary shall be consistent with the WBS and shall include all costs to NASA, along with all contributed costs. The Phase C/D time-phased cost summary shall be phased by fiscal year. Phase C/D extends 30 days beyond launch so be sure to account for all costs for this period, including tracking support and mission operations.

3. Operations and Sustainment (Phase E) Cost Estimate. This section provides a cost estimate for performing the Operations and Sustainment Phase (Phase E)

portion of the mission. The Phase E cost estimates should correlate with the plans set forth in the Science, Technical Approach, and Management sections. In completing this section, the following guidelines will apply:

- a. Work Breakdown Structure. A WBS must be included for the Mission Operations and Data Analysis Phase of the mission. The WBS should be consistent with the plans set forth in the Technical Approach and Management sections and the Statement of Work that is provided as an Appendix.
  - b. Cost Estimating Technique. Describe the process and techniques used to develop the Phase E cost estimate. For portions of the cost proposal developed using a grass-roots methodology, provide the bases from which the estimates were derived and details on how the estimates were extrapolated from the bases. For portions of the cost proposal derived from vendor quotes/historical actuals/catalogue prices/etc. include sufficient information to understand the fidelity of the values. For portions of cost in the CSR derived from analogies, describe the value of and the methodology for extrapolating the analogy. For portions of the cost proposal derived parametrically, provide a description of the cost-estimating model(s) and techniques used in your Phase E cost estimate. Discuss the heritage of the models applied to this estimate including any known differences between missions contained in the model's database and key attributes of the proposed mission. Include the assumptions used as the basis for the Phase E cost and identify those which are critical to cost sensitivity in the investigation. If any "discounts" were assumed in the cost estimates for business practice initiatives or streamlined technical approaches, describe how these have been incorporated in the cost estimate and will be managed by the investigation team.
  - c. Workforce Staffing Plan. Provide a workforce staffing plan (including civil service) which is consistent with the WBS. This workforce staffing plan must include all team member organizations and must cover all management, manufacturing, technical (scientific and engineering), and support staff. The workforce staffing plan must be phased by fiscal year. Time commitments for the PI, Co-Is, PM, and other key personnel must be clearly shown.
  - d. Phase E Time-Phased Cost Summary. Provide a summary of the total Phase E costs consistent with the WBS in Table 3. The Phase E cost summary should be developed consistent with the WBS and must include all costs to NASA SMD, along with all contributed costs. The Phase E time phased cost summary must be phased by fiscal year.
4. Closeout (Phase F) Cost Estimate. This section provides a cost estimate for performing the Closeout Phase (Phase F) of the mission. The Phase F cost

estimates should correlate with the plans set forth in the Science, Technical Approach, and Management sections. In completing this section, the following guidelines will apply:

- a. Work Breakdown Structure. A WBS must be included for the Closeout of the mission. The WBS should be consistent with the plans set forth in the Technical Approach and Management sections and the Statement of Work that is provided as an Appendix.
  - b. Cost Estimating Technique. Describe the process and techniques used to develop the Phase E cost estimate. For portions of the cost proposal developed using a grass-roots methodology, provide the bases from which the estimates were derived and details on how the estimates were extrapolated from the bases. For portions of the cost proposal derived from vendor quotes/historical actuals/catalogue prices/etc. include sufficient information to understand the fidelity of the values. For portions of cost the proposal derived from analogies, describe the value of and the methodology for extrapolating the analogy. For portions of the cost proposal derived parametrically, provide a description of the cost-estimating model(s) and techniques used in your Phase E cost estimate. Discuss the heritage of the models applied to this estimate including any known differences between missions contained in the model's database and key attributes of the proposed mission. Include the assumptions used as the basis for the Phase E cost and identify those which are critical to cost sensitivity in the investigation. If any "discounts" were assumed in the cost estimates for business practice initiatives or streamlined technical approaches, describe how these have been incorporated in the cost estimate and will be managed by the investigation team.
  - c. Workforce Staffing Plan. Provide a workforce staffing plan (including civil service) which is consistent with the Work Breakdown Structure. This workforce staffing plan must include all team member organizations and must cover all management, manufacturing, technical (scientific and engineering), and support staff. The workforce staffing plan must be phased by fiscal year. Time commitments for the PI, Co-Is, PM, and other key personnel must be clearly shown.
  - d. Phase F Time-Phased Cost Summary. Provide a summary of the total Phase F costs consistent with Table 2. The Phase F cost summary should be developed consistent with the Work Breakdown Structure and must include all costs to NASA SMD, along with all contributed costs. The Phase F time phased cost summary must be phased by fiscal year.
5. Total E/PO Cost Estimate: This section must summarize the estimated costs to be incurred in Phases A through F of the investigation for the E/PO component. Provide detailed E/PO cost information in the format of E/PO

Template 1, 2, and 3. Summary E/PO cost information must be provided in Tables 1 through 6 and be consistent with the E/PO Template information and the activities, products, programs, partnership arrangements, etc., defined in Section H.

6. Total Mission Cost (TMC) Estimate. This section must summarize the estimated costs to be incurred in Phases A through F including: Concept and Technology Development (Phase A), Preliminary Design and Technology Completion (Phase B); Final Design and Fabrication (Phase C); System Assembly, Integration and Test, and Launch, extending through in-orbit checkout, usually launch plus 30 days (Phase D); Operations and Sustainment (Phase E); Closeout (Phase F); launch vehicle, upper stages, and launch services; Deep Space Network and other ground system costs; and cost of activities associated with social or educational benefits (if not incorporated in any of Phases A through F). Table 1 must be used to summarize these costs. The total mission cost estimate should be developed consistent with the Work Breakdown Structure. Detailed plans for any aspects of the mission not discussed elsewhere in the CSR must be discussed here. The funding profile must be optimized for the mission. Contributions not included in the NASA SMD cost must be clearly identified as separate line items.

Immediately following the downselection, the contractor will be requested to submit a formal cost proposal based upon the Federal Acquisition Regulation (FAR) Part 15. The instruction and format for submission of this proposal are found in FAR Part 1 .403-5 and Table 15.2. The definitized contract will include an option provision for Phase B, C/D, E, and F with a not-to-exceed amount for each phase.

Requirement CS-68. The cost elements proposed in the formal proposal for contract award shall be traceable to the cost proposal provided in the CSR. Any changes in cost from the CSR shall be described in detail.

**TABLE 1**

**TOTAL MISSION COST FUNDING PROFILE TEMPLATE**  
(FY costs\* in Real Year Dollars, Totals in Real Year and FY 2008 Dollars)

Item	FY1	FY2	FY3	FY4	FY5	FYn	...	Total (Real Yr.)	Total (FY 2008)
Phase A	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
- Organization B									
- etc.									
Phase B	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
Phases C and D	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
Phase E	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
Phase F	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
<b>PI Mission Cost</b>	\$	\$	\$	\$	\$	\$	\$	\$	\$
Contributions by Organization (Non-U.S. or U.S.) to:									
Phase A	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
Phase B	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
Phases C and D	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
Phase E	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
Phase F	\$	\$	\$	\$	\$	\$	\$	\$	\$
- Organization A									
<b>Contributed Costs (Total)</b>	\$	\$	\$	\$	\$	\$	\$	\$	\$
<b>Total Mission Cost</b>								<b>\$</b>	

- Costs must include all costs including fee



**TABLE 2**  
(Phased costs in Real Year Dollars, Totals in Real Year and FY2008 Dollars)

<b>TIME PHASED COST BREAKDOWN BY WBS AND MAJOR COST CATEGORY</b>					
<b>WBS/Cost Category Description</b>	<b>FY1</b>	<b>FY2</b>	<b>...</b>	<b>Total (RY\$)</b>	<b>Total (FY2008\$)</b>
<b>Total Direct Labor Cost</b>	\$	\$	\$	\$	\$
WBS 1.0 Management					
WBS 2.0 Spacecraft					
WBS 2.1 Structures & Mechanisms					
WBS 2.2 Propulsion					
etc.					
<b>Total Subcontract Costs</b>	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
<b>Total Materials &amp; Equipment Cost</b>	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
<b>Total Reserves</b>	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
<b>Total Other Costs</b>	\$	\$	\$	\$	\$
WBS # and Description					
:					
etc.					
Fee					
E/PO					
Other (Specify)					
<b>Total Contract Cost</b>	\$	\$	\$	\$	\$
<b>Total Other Costs to NASA SMD</b>	\$	\$	\$	\$	\$
Launch Services					
Ground Segment					
E/PO					
Other (Specify)					
<b>Total Contributions (Non-U.S. or U.S.)</b>	\$	\$	\$	\$	\$
Organization A:					
WBS # and Description					
etc.					
Organization B:					
WBS # and Description					
etc.					
<b>TOTAL COST FOR PHASE</b>	\$	\$	\$	\$	\$

**Table 3**  
**Fiscal Year Costs in Real Year Dollars (to nearest thousand)**  
 (Totals in Real Year and Fiscal Year 2008  
 Dollars)

Cost Element Comparison Table													
FY Costs in Real Year Dollars (to nearest thousand), Totals in RY and FY08													
Proposal Name	Proposed Costs										RY	FY08	
Cost Element	NASA										TOTAL	TOTAL	Contributions
Phase A (Concept Study)													
Phase B/C/D (Development)													
	Phase B			Phase C/D				Phase E				Ph F	Ph B-F
	Year 1	Year 2	Total	Year 1	Year 2	Year 3	Year n	Total	Year 1	Year 2	Year n	Total	Total
Project Management													
Systems Engineering													
Safety & Mission Assurance													
Instrument #1													
Instrument #2													
Instrument #3													
Instrument #n													
Instrument Integration, Assembly and Test													
<b>Subtotal - Instruments</b>													
Spacecraft Bus													
Flight System Integration, Assembly and Test													
Other Hardware Elements (list each separately)													
Launch Ops (Launch+30 days)													
<b>Subtotal - Spacecraft</b>													
Science Team Support													
Pre-Launch GDS/MOS Development													
DSN/Tracking Support													
E/PO <sup>(1)</sup>													
Other <sup>(2)</sup>													
<b>Subtotal Phase B/C/D before Reserves</b>													
Instrument Reserves													
Spacecraft Reserves													
Other Reserves													
<b>Total Phase B/C/D</b>													
<b>Phase E &amp; F (Operations and Closeout)</b>													
Mission Operations & Data Analysis (including Project Management)													
DSN/Tracking Network													
Science Team													
E/PO <sup>(1)</sup>													
<b>Subtotal Phase E &amp; F before Reserves</b>													
Reserves													
<b>Total Phase E &amp; F</b>													
<b>Mission Unique &amp; Special Launch Services</b>													
<b>Total PI Mission Cost Phase A-F</b>													
<b>Contributions</b>													
Contribution 1 <sup>(3)</sup>													
<b>Total Mission Cost (with Contributions)</b>													
<b>Other Mission Costs</b>													
SEO <sup>(4)</sup>													
<b>Total Enhanced Mission Cost (w/o Contr.)</b>													
<b>4 month Bridge Phase (included w/ Phase B) <sup>(5)</sup></b>													
Notes													
<sup>(1)</sup> E/PO Education and Public Outreach. If a Student Collaboration (SC) is included, split E/PO into two lines - one for E/PO core and one for SC.													
<sup>(2)</sup> Specify each item on a separate line; include facilities, etc.													
<sup>(3)</sup> Specify totals from each contribution on separate lines.													
<sup>(4)</sup> Science Enhancement Opportunity (SEO) costs may be shown on more than one line if more than one SEO is proposed.													
<sup>(5)</sup> Also include within Phase B and the PI Mission Cost.													

**TABLE 5**  
**CO-I COMMITMENT AND COST**  
**FUNDING PROFILE TEMPLATE**

(FY costs in Real Year Dollars, Totals in Real Year and FY2008 Dollars)

	Phase B	Phases C and D	Phase E	Total (Real Year)	Total (FY 2008)
<b><i>NASA SMD Cost</i></b>					
Co-I #1 Name/Organization					
Percent Time					
Cost					
Co-I #2 Name/Organization					
Percent Time					
Cost					
Co-I #n Name/Organization					
Percent Time					
Cost					
<b>Total NASA SMD Co-I Cost</b>					
<b><i>Contributions</i></b>					
Co-I #1 Name/Organization					
Percent Time					
Cost					
Co-I #2 Name/Organization					
Percent Time					
Cost					
Co-I #n Name/Organization					
Percent Time					
Cost					
<b>Total Contributed Co-I Cost</b>					

**TABLE 6**  
**NASA CIVIL SERVICE COSTS**  
**FUNDING PROFILE TEMPLATE**  
(FY costs in Real Year Dollars, Totals in Real Year and FY2008 Dollars)

Item	FY1	FY2	FY3	FY4	FY5	FYn	...	Total (Real Yr.)	Total (FY 2008)
Workforce	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
- NASA Center B									
- etc.									
Facilities	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
E/PO, Other*	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
<b>NASA Civil Service Costs included in NASA SMD Cost</b>	\$	\$	\$	\$	\$	\$	\$	\$	\$
Contributions by NASA Centers									
Workforce	\$	\$	\$	\$	\$	\$	\$	\$	\$
- NASA Center A									
- NASA Center B	\$	\$	\$	\$	\$	\$	\$	\$	\$
- etc.	\$	\$	\$	\$	\$	\$	\$	\$	\$
Facilities									
- NASA Center A									
E/PO, Other*									
- NASA Center A									
<b>Contributed NASA Civil Service Costs</b>	\$	\$	\$	\$	\$	\$	\$	\$	\$
<b>Mission Totals</b>								\$	

\*Specify each item on a separate line.

**E/PO Template #1**  
**E/PO Program Budget**

(FY costs in Real Year Dollars, Totals in Real Year and FY 2008 Dollars)

	FY1	FY2	FY3	FYn	Total (Real Yr.)	Total (FY 2008)
Personnel						
Subcontract #1						
Subcontract #2						
Subcontract #n						
Consultants						
Equipment						
Supplies						
Travel						
Other Direct Costs						
Facilities						
Administration						
Other Indirects						
Subtotal						
Cost Sharing						
TOTAL						

## INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #1

Requirement CS-69. Provide, as attachments, detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.

1. Personnel: Attachments shall list the number and titles of personnel, amounts of time to be devoted to the project, and rates of pay including salaries, wages, and fringe benefits.
2. Subcontracts/Partners/Co-I Institutions: Attachments shall describe the work to be subcontracted, estimated amount, recipient (if known), and the reason for subcontracting. Enter the annual totals on this budget summary page. In addition, complete a more detailed budget summary form describing the subcontractor's/partner's/Co-I institution's use of NASA funds that the proposer requested through this solicitation (see Template #2 format).
3. Consultants: Identify consultants to be used, why they are necessary, the time (number of days) they will spend on the project, and quoted daily rates of pay. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
4. Equipment: List separately. Explain the need for items costing more than \$5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Contracting Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the work proposed and why it cannot be purchased with indirect funds.
5. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
6. Travel: Describe the purpose of the proposed travel in relation to the contract and provide the basis of estimate, including information on destination, number of trips, and number of travelers where known.
7. Other Direct Costs: Enter the total of direct costs not covered by 1 through 6. Attach an itemized list explaining the need for each item and the basis for the estimate.
8. Facilities and Administration (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
9. Other Indirects: Enter the total of indirect costs not covered by 8. Attach an itemized list explaining the need for each item.
10. Subtotal: Enter the sum of items 1 through 9.
11. Cost Sharing: Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.
12. Total: Enter the total after subtracting item 11 from item 10.

**E/PO Template #2**  
**Subcontract Budgets**  
(Costs in Real Year Dollars, Totals in Real Year and FY 2008 Dollars)

	Subcontract #1	Subcontract #2	Subcontract #n
Personnel			
Consultants			
Equipment			
Supplies			
Travel			
Other Direct Costs			
Facilities			
Administration			
Other Indirects			
Subtotal			
Cost Sharing			
TOTAL (Real Yr.)			
TOTAL (FY 2008)			

## INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #2

Requirement CS-70. Provide, as attachments, detailed computations of all estimates in each cost category with narratives as required to fully explain each proposed cost as follows.

1. Personnel: Attachments shall list the number and titles of personnel, amounts of time to be devoted to the project, and rates of pay including salaries, wages, and fringe benefits.
2. Consultants: Identify consultants to be used, why they are necessary, the time (number of days) they will spend on the project, and quoted daily rates of pay. State whether the consultant has been compensated at the quoted rate for similar services performed in connection with Government contracts.
3. Equipment: List separately. Explain the need for items costing more than \$5,000. Describe basis for estimated cost. General purpose equipment is not allowable as a direct cost unless specifically approved by the NASA Contracting Officer. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the work proposed and why it cannot be purchased with indirect funds.
4. Supplies: Provide general categories of needed supplies, the method of acquisition, and the estimated cost.
5. Travel: Describe the purpose of the proposed travel in relation to the project and provide the basis of estimate, including information on destination, number of trips, and number of travelers where known.
6. Other Direct Costs: Enter the total of direct costs not covered by 1 through 5. Attach an itemized list explaining the need for each item and the basis for the estimate.
7. Facilities and Administration (F&A) Costs: Identify F&A cost rate(s) and base(s) as approved by the cognizant Federal agency, including the effective period of the rate. Provide the name, address, and telephone number of the Federal agency official having cognizance. If unapproved rates are used, explain why, and include the computational basis for the indirect expense pool and corresponding allocation base for each rate.
8. Other Indirects: Enter the total of indirect costs not covered by 7. Attach an itemized list explaining the need for each item.
9. Subtotal: Enter the sum of items 1 through 8.
10. Cost Sharing: Enter any amount proposed. If cost sharing is based on specific cost items, identify each item and amount in an attachment.
11. Total Estimated Costs: Enter the total after subtracting item 10 from item 9.



## E/PO Template #3

### Key Personnel

(Percent Time Committed/Direct Costs, Including Benefits,  
in Real Year Dollars, Totals in Real Year and FY 2008 Dollars)

	FY1	FY2	FY3	FYn	Total (Real Yr.)	Total (FY 2008)
Institution 1						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						
Institution 2						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						
Institution n						
PI (% time)						
PI (direct cost)						
E/PO lead (% time)						
E/PO (direct cost)						

### INSTRUCTIONS FOR E/PO BUDGET SUMMARY – TEMPLATE #3

Requirement CS-73. Workforce staffing plan for key personnel shall be phased by fiscal year. In tabular form, the Workforce Table for Key Personnel shall provide the names and intended work commitment for the mission PI and key E/PO personnel of the investigation, both in time (rounded to the nearest 0.01 of a Work Year typically of 1880 hours) and salary (without addition of overhead or fees - rounded to the nearest \$1K) for each year of the proposed period of performance.

## L. JUSTIFICATION AND COST PROPOSAL FOR ANY SEO ACTIVITIES

SEO activities, discussed in Section 3.3.2 of the AO, include extended missions, guest investigator programs, general observer programs, and archival data analysis programs. The selections from the Step 1 proposals were made primarily on the merit of the baseline proposed science; no prejudice or commitment to any attendant proposed SEO activity was made at selection. It is incumbent upon proposers, therefore, to fully discuss these project additions in the CSR.

Funding for SEO activities are outside the AO cost caps, and will therefore result in a separate decision by NASA as to whether to accept or reject these proposed expansions to the baseline science mission. Therefore, the CSR must provide sufficient clarity to allow contractual execution if NASA elects to fund any SEO activities.

All definitions, guidelines and constraints outlined in the AO and applicable to SEOs are still valid for the Concept Study. There are no page count limits for narrative descriptions, rationale, and data for these enhancements, but conciseness and brevity are encouraged.

Requirement CS-72. If applicable, this section shall provided sufficient data and justifications to enable analysis of not only the science value of the concept, but also its viability and cost. This section shall also provide a cost estimate for performing any SEO activities. In completing the Cost section, the guidelines for Phases B through D apply. Complete a one page summary of costs using the format shown in Table 7. Also, include the total amount in the SEO line item at the bottom of Table 3. Include a discussion of the estimating techniques used to develop the cost estimates.

**TABLE 7**  
**FUNDING PROFILE TEMPLATE FOR ANY SEO ACTIVITIES**  
(FY costs in Real Year Dollars, Totals in Real Year and FY 2008 Dollars)

Item	FY1	FY2	Fyn	Total (Real Yr.)	Total (FY 2008)
Extended Mission	\$	\$	\$	\$	\$
- Organization A					
- Organization B					
- etc.					
Guest Investigator Program	\$	\$	\$	\$	\$
- Organization A					
General Observer Program					
- Organization A					
Archival Data Analysis Program	\$	\$	\$	\$	\$
- Organization A					
<b>Additions to NASA SMD Cost</b>	\$	\$	\$	\$	\$

## M. APPENDICES

The following additional information is required to be supplied with the CSR. This information can be included as Appendices to the CSR, and, as such, will not be counted within the specified page limit.

### 1. Letters of Commitment.

Requirement CS-73. This appendix shall include letters of commitment from (i) all organizations offering contributions of goods and/or services (including Co-I services, both U.S. and non-U.S.) on a no-exchange-of-funds basis, including all non-U.S. organizations providing hardware or software to the investigation and (ii) all major or critical participants in the proposal regardless of source of funding, signed by officials authorized to commit the resources of the respective institutions or organizations. Critical participants are those participants who are assigned tasks considered by the PI to be critical to the success of the mission, including those who provide unique required services. All other participants are non-critical. See AO section 5.8.1 for detailed definitions of i, ii, and iii.

Requirement CS-74. This appendix shall include letters of commitment from non-U.S. individuals and/or institutions that are team members or contributors to New Frontiers investigations. These letters of commitment shall provide evidence that the non-U.S. institution and/or government will commit the appropriate technical, personnel, and funding resources to the proposed investigation if selected by NASA. **Such commitments shall be submitted no later than the site visit.**

The required elements in a letter of commitment are: a precise description of what is being contributed by the partner and what assumptions are being made about NASA's role; the strongest possible statement of whether the contribution will be funded, or what further decisions must be made before the funding is committed by the partner. An authorized officer or representative of the partner institution or government must sign the respective letter of commitment.

Letters of commitment provided for Step 1 proposal can be reused if the description of the commitment is unchanged and if the letter of commitment meets the requirements for letters of commitment for the Concept Study Report.

### 2. Relevant Experience and Past Performance.

In evaluating the CSR, NASA will consider the past performance of the major partner organizations. The evaluation of past performance will not be arithmetic; instead, the information deemed to be most relevant and significant will receive the greatest consideration. Relevant experience will be viewed as the demonstrated accomplishment of work, which is comparable or related to the objectives of the CSR. This includes space-based instrument development and investigations and associated development processes including engineering processes, management processes, operations, data analysis and delivery of data to the PDS or other appropriate data archives. NASA will review the past performance information provided by the proposer. In addition, NASA may review the major team partners past performance on other NASA and/or non-NASA

projects or contracts that provide insight into those institutions past performance on airborne or space-based instrument development and investigations and associated development processes including engineering processes, management process, operations, data analysis and delivery of data to the appropriate data archive. In conducting the evaluation, NASA reserves the right to use *all* information available.

Requirement CS-75. This appendix shall describe *relevant* experience and past performance by the major team partners (organizations) in meeting the requirements of projects *similar* to the subject of the CSR. This may include space-based instrument development and investigations. The discussion of relevant experience and past performance shall include a description of each project; its relevance to the subject of the CSR; the proposed performance and the actual performance; the planned delivery schedule of data to the appropriate data archive and the actual delivery schedule of data to the appropriate data archive, the proposed cost and actual cost; the proposed schedule and actual schedule; an explanation of any differences between proposed performance, cost and schedule and what was actually achieved; and points of contact for the past project's customer. If the customer for the past project was the United States government, then the contract number must be included along with current technical point(s) of contact and phone number(s). For projects that are not yet complete, the current projected performance, cost, and schedule must be used in place of actual values. Projects that ended more than 5 years ago need not be included.

*Investigation teams are cautioned that omissions or an inaccurate or inadequate response to this evaluation item will have a negative effect on the overall evaluation, and while NASA may consider data from other sources, the burden of providing relevant references that NASA can readily contact rests with the investigation team.*

3. Resumes.

Requirement CS-76. This appendix shall include resumes or curriculum vitae for the PI and all Co-Is identified in the Science section, for any key project personnel identified in the Management section, and for key E/PO lead personnel. The resumes shall clearly indicate experience related to the job the individual will perform on the proposed investigation. Any project management experience that the PI or PM have shall be included in their resumes. Resumes or curriculum vitae shall be no longer than three pages for the PI and PM, and one page for each additional participant.

4. Statements of Work for each Contract Option.

Requirement CS-77. This appendix shall provide draft Statement(s) of Work (SOWs) for all potential contracts with NASA. At a minimum, SOWs shall be provided for each contract option (i.e., Phases B through F) and shall clearly define all proposed deliverables (including science data) for each option, potential requirements for Government facilities and/or Government services, and a proposed schedule for the entire mission.

5. Mission Definition and Requirements Agreement.

Requirement CS-78. This appendix shall provide a draft Mission Definition and Requirements Agreement. An example of a Mission Definition and Requirements Agreement is provided in the New Frontiers Program Library.

6. Data Management Plan

Requirement CS-79. This appendix shall provide a discussion of all plans (schedules, costs, and deliverables) and their approach and commitment to delivering project data to the appropriate NASA data archives and indicate such in the plans and schedules for Phase B. This discussion shall also provide assurance that that all activities (womb to tomb) have been considered and included with appropriate resources separately allocated and budgeted.

7. Incentive Plan(s).

Requirement CS-80. If applicable, the appendix shall provide draft incentive plans. Incentive Plans must outline contractual incentive features for all major team members. Incentive plans must include both performance and cost incentives, as appropriate.

8. Technical Content of any International Agreement(s).

Requirement CS-81. Draft language for the technical content of any International Agreement(s) are required for all non-U.S. partners in the investigation. A sample agreement is available in the Program Library. The draft language must include (i) a brief

summary of the mission and the foreign partner's role in it, (ii) a list of NASA's responsibilities within the partnership, and (iii) a list of the non-U.S. partner's responsibilities in within the partnership. Note that NASA prefers to establish agreements with government funding agencies, not with the institution that will be funded to perform the work.

9. International Participation Plans - Discussion of Compliance with U.S. Export Laws and Regulations.

Requirement CS-82. If the investigation includes international participation, either through involvement of non-U.S. nationals and/or involvement of non-U.S. entities, this appendix shall describe any updates to plans for compliance with U.S. export laws and regulations, *e.g.*, 22 CFR 120-130, *et seq.* and 15 CFR 730-774, *et seq.*, provided in the Step 1 proposal (see Section J.5 of Appendix B in the AO). The discussion shall describe in detail the proposed international participation and shall include, but not be limited to, whether or not the international participation may require the proposer to obtain the prior approval of the Department of State or the Department of Commerce via a technical assistance agreement or an export license or whether a license exemption/exception may apply. If prior approvals via licenses are necessary, discuss whether the license has been applied for or, if not, the projected timing of the application and any implications for the schedule. Information regarding U.S. export regulations is available at <http://www.pmddtc.state.gov/> and <http://www.bis.doc.gov/>. Proposers are advised that under U.S. law and regulation, spacecraft and their specifically designed, modified, or configured systems, components, parts, etc., such as instrumentation responsive to this AO, are generally considered “Defense Articles” on the United States Munitions List and subject to the provisions of the International Traffic in Arms Regulations (ITAR), 22 CFR 120-130, *et seq.*

10. Planetary Protection Plan

Requirement CS-83. If applicable, this section shall describe the plan for compliance with the planetary protection requirements described in Section 5.1.5.1 of the AO. At a minimum, it shall address (i) the anticipated planetary protection Category of the mission under NASA directives; (ii) the proposed mission operational accommodations to comply with the anticipated requirements, including organizational responsibilities; and (iii) the proposed steps to be taken for the preparation of orbital and/or landed portions of the spacecraft to comply with any requirements for overall microbiological cleanliness and recontamination prevention prior to launch. If describing a sample return mission, this appendix shall additionally address (iv) the nature of the proposed implementation of back-contamination control and subsequent containment and testing of returned samples or the proposed rationale for the mission to be relieved from a containment requirement. This appendix shall address steps intended to be taken for planetary protection compliance and the implementing organization(s) responsible for implementing those steps.

11. Sample Curation Plan

Requirement CS-84. If applicable, this section shall describe the plan for sample allocation and curation at the NASA JSC Astromaterials Curatorial Facility, in accordance with requirements described in Section 5.1.5.2 of the AO. At a minimum, this plan shall describe (i) the nature of samples expected to be returned, (ii) the methods used to prevent sample contamination or degradation during collection and return to Earth, (iii) the environmental conditions of the sample curatorial facility, (iv) the general procedures for storage, subsampling, documentation, distribution, and security, (v) the preliminary examination of the samples, and (vi) the preparation (within 6 months of return) of a sample catalog sufficient for other scientists to request samples. The plan shall demonstrate that at least 75% of the returned sample shall be preserved for future studies.

## 12. End of Mission Spacecraft Disposal Requirements.

This appendix is required only for missions to Low Earth Orbit (LEO) (<2000 km perigee), near Geosynchronous orbit (GEO) ( $\text{GEO} \pm 300 \text{ km}$ ), or the Moon (orbiters and landers).

NASA policy requires all objects launched into space to perform a formal Orbital Debris assessment, to limit the amount of orbital debris generated. Orbital Debris is defined as any object that humans have placed in space, that remains in orbit and no longer serves any useful function or purpose. Such objects range from spacecraft to spent launch vehicle stages to instruments, as well as materials, trash, refuse, fragments, or other objects that are deliberately or inadvertently cast off or generated. Every selected investigation team must conduct a formal assessment during Phase A of the orbital debris the spacecraft or instrument will create upon mission termination. NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris, and NASASTD-8719.14, NASA Process for Limiting Orbital Debris, are available in the New Frontiers Program Library.

Requirement CS-85. For LEO missions, this section shall briefly discuss the lifetime of the mission and whether it meets the 25-year postmission (or 30-year from launch, whichever comes first) requirement for LEO missions or, alternatively, how the mission meets the orbit disposal requirement applicable for its proposed orbit.

This section shall include a mission lifetime analysis demonstrating satisfaction of the above requirement, addressing all assumptions and inputs contributing to the analysis. These assumptions and inputs shall include, at a minimum:

- Vehicle Mass
- Drag Area or Cross-sectional Area
- Initial orbit used for the analysis
- Solar and atmospheric conditions assumptions (*i.e.*, models or parameters)
- Methodology: analytical tool, table lookup, reference plot.

If the plan is to dispose of the satellite at the end of mission, this appendix shall provide the parameters of the disposal orbit, the delta-v allocation for disposal, and any other relevant assumptions.



Requirement CS-86. For Lunar missions, this section shall include a discussion of how end-of-mission requirements will be met.

13. Compliance with Procurement Regulations by NASA PI Proposals.

This appendix is required only for proposals submitted by NASA PIs or NASA Centers (excluding JPL). Proposals submitted by NASA Centers must comply with regulations governing proposals submitted by NASA PIs (NFS 1872.308). Additional instructions may be found in Procurement Information Circular (PIC) 05-15 at <http://www.hq.nasa.gov/office/procurement/regs/pic.html>.

Requirement CS-87. For NASA Center proposals, this section shall include any descriptions, justifications, representations, indications, statements, and/or explanations that are required by the regulations.

14. Master Equipment List.

Requirement CS-88. This appendix shall include a Master Equipment List (MEL) summarizing all flight element subsystem components and individual instrument element components to support validation of proposed mass estimates, design heritage, and cost. A template for this MEL is included as Table B5 in Appendix B of the AO.

Requirement CS-89. The MEL shall be additionally provided in EXCEL format on each CD submitted with the CSR.

15. Heritage.

Requirement CS-90. This section shall discuss each element of any heritage from which the proposed investigation derives substantial benefit, including heritage from spacecraft subsystems, instruments, ground systems, flight and ground software, test set ups, simulations, analyses, etc. This discussion shall be at an appropriate level of granularity (e.g., component, assembly, subsystem) to clearly separate the heritage element from other elements of the design. The discussion of each element shall include:

- A concise description of the design heritage claimed;
- Anticipated benefits to the proposed investigation;
- A brief rationale supporting the claim that the benefits of heritage will be achieved; and
- For any proposed elements with substantial design heritage, a comparison of the cost of the heritage items to the proposed cost.

CSRs shall substantiate all heritage claims, including descriptions of changes required to accommodate project-unique applications and needs. Where enhancements to heritage elements are proposed or heritage is from a different application, sufficient descriptions must be provided to independently assess the current level of maturity.

The evaluation team will use a scale with at least three levels (full, partial, or none) as illustrated in the table below.

	<b>Full heritage</b>	<b>Partial heritage</b>	<b>No heritage</b>
<b>Design</b>	Identical	Minimal modifications	Major modifications
<b>Manufacture</b>	Identical	Limited update of parts and processes necessary	Many updates of parts or processes necessary
<b>Software</b>	Identical	Identical functionality with limited update of software modules (<50%)	Major modifications (>=50%)
<b>Provider</b>	Identical provider and development team	Different however with substantial involvement of original team	Different and minimal or no involvement of original team
<b>Use</b>	Identical	Same interfaces and similar use within a novel overall context	Significantly different from original
<b>Operating Environment</b>	Identical	Within margins of original	Significantly different from original
<b>Referenced Mission</b>	In operation	Built and successfully ground tested	Not yet successfully ground tested

16. Acronyms List.

17. References List (Optional).

Concept studies may provide, as an appendix, a list of reference documents and materials used in the concept study. The documents and materials themselves cannot be submitted, except as a part of the concept study. Proposers are encouraged to include a URL for those documents available through the Internet.

18. SDB Subcontracting Plan.

Requirement CS-91. A preliminary subcontracting plan, outlining the proposed investigation's approach to small and small disadvantaged business subcontracting as described in Appendix A, Section XIII, of the AO, shall be provided. This plan will be negotiated prior to any Phase B contract award.

19. Additional Cost Data to Assist Validation.

In addition to the specific cost table data requested in the Cost Proposal, Section J, proposers should also provide any additional costing information/data which they feel will assist NASA to validate the project's proposed costs. Vendor quotes, cost estimates, rationale for design heritage cost savings, are all examples of data that can be included here.

All costs in the lowest level of the proposer's WBS should be provided in Microsoft Excel format.

20. Science Change Matrix.

Requirement CS-92. If the Phase A effort results in changes from any science objective proposed in Step 1, this appendix shall provide the original requirement, the new or revised requirement, rationale for the change, and the section/paragraph in the CSR where the change occurs.

21. Communications Link Budget Design Data.

Requirement CS-93. Include communications block diagram and link budget design control tables for all radio communications links(data and carrier) showing relevant spacecraft and earth station parameters and assumptions for the highest data rate and the emergency link at the maximum distance and throughput at which each particular link could be used. Particularly, provide losses, loop bandwidths, coding, antenna gains, and such other parameters identified in the document *NASA's Mission Operations and Communication Services*, in the Small Explorer Program Library.

22. Cost and Pricing for Bridge Phase Contract and Phase B .

Requirement CS-94. To ensure that the deliverables via the CSR facilitate a direct and easily implementable Bridge Phase contract, this appendix shall provide cost and pricing data for the Bridge Phase and Phase B, which meet the requirements of the FAR Part 15 Table 15-2. This Bridge Phase cost and pricing data are necessary and required to implement the contract. These data are *in addition* to the data provided in Cost tables 1-6 for evaluation purposes, allocate project costs per the cost categories defined in Table 15-2, but still align at the highest levels with the evaluation data. Also see Section J of Part II above for additional guidance.